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ABSTRACT

The beneficial effects of changing an answer on a multiple choice test were examined for elementary school students, with particular emphasis on the answer-changing behavior of minority versus non-minority groups and high-income versus low-income students. Test booklets from students in grade 2 and answer sheets from students in grades 4, 6, and 8 were examined for types and numbers of response changes made to the Iowa Tests of Basic Skills (ITBS). Students were categorized according to ethnic group (Black, Hispanic, or Anglo); family income (low or not low); sex; and achievement level indicated by ITBS composite percentile score. Three types of answer changes were recorded: (1) right to wrong; (2) wrong to right; and (3) wrong to wrong. Results were similar to those reported in other studies: 56 percent of the changes were from an incorrect answer to the correct one, 17 percent were from correct to incorrect, and 27 percent were from one wrong answer to another. All students changed at least one answer, resulting in higher scores for 88 percent and lower for 6 percent. Second graders and Black students averaged the most changes. There was no significant difference in the number of answer changes by low versus nonlow income students, but low income students benefited slightly less from their changes. (GDC)

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Eenie, Meenie, Minie, Mo — Change This Answer — Yes or No?

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Paper Presented at the Annual Meeting of the
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Eenie, Meenie, Minie, Mo — Change This Answer — Yes or No?

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Most of us have experienced this situation:

> You've finished a multiple-choice test (using a separate, machine-scorable answer sheet) with a few minutes remaining in the testing period. Instead of taking a catnap, you decide to use a good test-taking strategy of reviewing your answers. You agree with the answer recorded on the answer sheet for the first six items reviewed. However, upon reexamination of the seventh item, you decide that your initial response may not have been the correct one, that another foil looks more like the "correct" answer. So, you wonder, "Should I or should I not change my answer?" What do you do? What do you do?

Overwhelmingly, public opinion says "Don't change your answer; go with your first response." Even more overwheming comes the research reply, "If you feel your first response is not correct, change it."

What is this research response based on? A few articles in Reader's Digest and The National Enquirer? No, more than 32 studies spanning the past 50 years has shown that the majority (about 55%) of answers which are changed on multiple-choice objective tests are from an incorrect to the correct option (see Matter, 1985). If that isn't positive enough, about 26% of changed answers do no harm at all, being from one incorrect foil to another. Correct-to-incorrect answer changing occurs in only about 19% of the cases. Researchers have found that four individuals receive higher test scores for every one individual who receives a lower test score as a result of changing answers on a multiple-choice test (see Matter, 1985).

With answer-changing behavior so profitable, a question arises as to whether any one group of individuals is more adept at making incorrect-to-correct answer changes than another group. This would not matter if test scores played a minute role in education. However, today test scores play an ever-increasing role in our educational systems. A multitude of tests are used for assessing student achievement levels, including ones for high school graduation (minimum competency), college entrance, grade promotion, and in the classroom. In many districts educational decision-making relys heavily on test scores using multiple-choice items. This gives additional meaning and importance to these scores and the impact of changing answers on individual test items to the final test score.

The answer changing percentages noted above are stable and consistent across content areas (e.g., statistics, psychology, child development, economics, chemistry, measurement, education, and educational psychology) and over time. High-achieving students tend to gain more than low-achieving students (Beck, 1978; Mueller & Shwedel, 1975; Smith & Moore, 1976), but even the latter profit from changing answers (Lynch & Smith, 1975; Reile & Briggs, 1952).

Until recently, however, several gaps in the research remained, particularly regarding possible ethnic group and family income differences in answer-changing behavior. Minority students and students from low-income families typically score lower on standardized achievement tests than non-minority students and those from higher-income families. But are minority and low-family-income students less likely to change answers, thereby underestimating their knowledge levels compared to majority and higher-family-income students? The research reported here was designed to fill in some of these gaps regarding ethnic group and family income differences in answer-changing behavior, as well as extend the range of inquiry into the lower elementary grades. This study would thereby make the research much more applicable to the public school setting.

Instruments and Methods

Test booklets (grade 2) and answer sheets (grades 4, 6, and 8) were examined for types and numbers of response changes made to a standardized achievement test, Form 7 of the Iowa Tests of Basic Skills (ITBS). The sample included 1903 booklets and answer sheets (about 475 per grade), which were randomly selected within four categories of variables: ethnic group (Black, Hispanic, Anglo), family income (Low, Nonlow), sex (Male, Female), and achievement level (Total ITBS Battery Composite Percentile Score). Each cell in the analysis included about 40 subjects (see Table 1). Low family income students were eligible to receive either free or reduced-price meals in the school district, while nonlow family income students were not eligible for either free or reduced-price meals. Only students who were in the school district (a large, urban district in central Texas) for two years and who took the entire ITBS both years were eligible for selection for the sample. (This restriction deleted about 20% of the students at each grade from possible examination. About 3200 students in each grade had test scores for both years; therefore about 15% of this total number of possible "useable" answer sheets and test booklets were examined in this study.)

TABLE 1

NUMBER OF STUDENTS IN SAMPLE BY GRADE, SEX, ETHNICITY, AND FAMILY INCOME LEVEL

FAMILY INCOME	SEX	BLACK	HISPANIC	ANGLO	GRADE
Nonlow	Male	40	40	39	2
	Female	39	39	40	2
Low	Male	40	40	40	2
	Female	40	39	40	2

FAMILY INCOME	SEX	BLACK	HISPANIC	ANGLO	GRADE
Nonlow	Male	40	39	39	4
	Female	39	39	39	4
Low	Male	40	39	40	4
	Female	40	40	40	4

FAMILY INCOME	SEX	BLACK	HISPANIC	ANGLO	GRADE
Nonlow	Male	40	40	40	6
	Female	41	40	40	6
Low	Male	39	40	39	6
	Female	39	39	40	6

FAMILY INCOME	SEX	BLACK	HISPANIC	ANGLO	GRADE
Nonlow	Male	39	40	39	8
	Female	39	40	40	8
Low	Male	39	40	40	8
	Female	40	40	40	8

The answer sheets (grades 4, 6, and 8) and test booklets (grade 2) from the selected students were examined by coders for evidence of answer changes. Three categories of changes were recorded, for each student, for the entire ITBS test:

R-W = Answer changed from the right (correct) alternative to a wrong (incorrect) alternative.

W-R = Answer changed from a wrong (incorrect) alternative to the right (correct) alternative.

W-W = Answer changed from a wrong (incorrect) alternative to another wrong (incorrect) alternative.

In the few instances in which more than one answer change was made to an item, the initial response was selected at random.

Using rules developed for determining answer changes (see Appendix A), the interrater reliability of recognizing changed answers from a sample of 25 answer sheets was .96. This high reliability, coupled with the ease of recognizing changed responses, prompted the use of only one coder to examine each answer sheet or test booklet. Coders recorded the test, item number, initial response, and final response of any changed answer onto coding sheets. Consistent with other studies, about 3% of all test items were changed.

A methodological improvement over previous studies was the elimination of possible changes due to mismarking of the answer sheet. Assuming each change is independent, a .0009 probability exists that response changes would be made to two items in a row, with a .000027 probability for changes to three items in a row. With this low probability, responses which could be regarded as suspicious in nature were deleted from inclusion in statistical analyses. Specifically, answer changes made to three or more test items in a row were excluded, since these changes more than likely were mismarkings of the answer sheet and not really answer changes to items on the test. Only information on "isolated" item answer changes or changes to two items in a row were used for data analysis.

Additionally, all the coding sheets were examined for "runs" of changes within a test, in which many items in a particular test area were changed. The answer sheet which corresponded to this coding sheet was examined and if it appeared that the student mismarked an entire test in the wrong area of the answer sheet, the answer changes for that test were not included in the data processing.

Thus, much care was taken to eliminate answer sheet mismarkings as a source of response changes, and to include only "true" changes in the data analyses.

Results and Discussion

The results of this study indicate that the answer-changing behavior of students in grades 2, 4, 6, and 8 is very similar to subjects used in other studies. The majority of changes were from an incorrect to the correct response (56%), with few changes made from the correct to an incorrect option (17%) (see Tables 2 and 3). This pattern was similar regardless of grade, sex, ethnic group, and family income status, with the most variability evident in the results by grade.

Every student in the sample changed at least one response, with the mean equal to 11.5 changes over the entire test. As shown in Table 4, students in grade 2 had the highest average number of changes (12.99), despite having the fewest number of test items to change. Black students averaged the most changes (12.05), with Anglo students the fewest (10.96). Students from nonlow income families made slightly more changes than low family income students (11.52 vs. 11.42).

The mean net score gain (the number of W-R changes made by a group minus the number of R-W changes for that group divided by the total number of subjects in the group) for the whole sample was 4.49 items. The trend was for students to gain less as they progressed through school (see Table 5). Nonlow family income students made a greater item gain than low family income students (4.88 vs. 4.11).

There is no ITBS score based upon the total raw score, so this average gain of 4.5 items must be broken down by subtest. It is unlikely that any one subtest had more than a one item gain in it due to answer changing. So, while the overall gain is impressive, it may not make much difference in the overall score, because it is distributed over many test items (271 items at grade 2; 465 items at grade 8). On the ITBS, a raw score difference of one item is about a one to six month grade equivalent change (larger at the extremes), which in turn is about a one to six percentile rank change in score (larger at the middle of the distribution). Thus, a gain of two items on the Reading Comprehension test at grade 4 (Level 10, on level) would increase one's score (using spring norms) from the 25%ile to the 31%ile, or from the 50%ile to the 55%ile, or from the 75%ile to the 81%ile.

Only 5.9% of the students received a lower test score (lost items) as a result of changing answers, with 88% receiving a higher score (gained items). As seen in Table 6, fewer Anglo students had a lower overall score due to answer changing, as well as fewer male and nonlow family income students. More nonlow family income students, Anglo students, and grade 6 students earned higher scores through answer-changing behavior. Thus, very few students were penalized because they changed responses, with the overwhelming majority of students earning a higher score than they would have received had they not changed any of their answers on the test. (Text continues on page 10.)

TABLE 2

TOTAL NUMBER AND PERCENT OF OF ANSWER CHANGES

CATEGORY	NUMBER	PERCENT
R-W	3642	16.68
W-R	12195	55.87
W-W	5992	27.45
TOTAL	21829	

TABLE 3

PERCENT OF ANSWER CHANGES BY TYPE FOR MAJOR GROUPS

TYPE	GRADE 2	GRADE 4	GRADE 6	GRADE 8
R-W	20	14	16	16
W-R	58	59	56	54
W-W	22	28	29	30

TYPE	BLACK	HISPANIC	ANGLO
R-W	17	17	16
W-R	55	55	59
W-W	28	28	25

TYPE	MALE	FEMALE
R-W	16	16
W-R	57	56
W-W	27	28

TYPE	NONLOW INCOME	LOW INCOME
R-W	15	17
W-R	59	54
W-W	26	28

(Note: Totals may not equal 100% due to rounding)

TABLE 4

MEAN NUMBER OF ANSWER CHANGES FOR THE TOTAL SAMPLE

	Range	Mean	s.d.
#W-R	0-24	6.408	3.865
#R-W	0-14	1.914	1.835
#W-W	0-17	3.149	2.505
Total	1-40	11.471	6.133

GRADE 2	GRADE 4	GRADE 6	GRADE 8
12.99	10.35	11.55	10.99

BLACK	HISPANIC	ANGLO
12.05	11.41	10.96

MALE	FEMALE
11.21	11.73

NONLOW INCOME	LOW INCOME
11.52	11.42

TABLE 5

MEAN NET SCORE GAIN FOR TOTAL GROUP
[(#W-R minus #R-W) ÷ Group N]

Total Sample
4.49

GRADE 2	GRADE 4	GRADE 6	GRADE 8
4.91	4.57	4.54	3.96

BLACK	HISPANIC	ANGLO
4.53	4.23	4.72

MALE	FEMALE
4.47	4.52

NONLOW INCOME	LOW INCOME
4.88	4.11

TABLE 6

NUMBER AND PERCENT RECEIVING A HIGHER, LOWER,
OR THE SAME SCORE AS A RESULT OF CHANGING ITEMS

TOTAL SAMPLE

LOWER	112 (5.9%)
HIGHER	1674 (88.0%0
SAME	117 (6.1%)

TYPE	GRADE 2	GRADE 4	GRADE 6	GRADE 8
LOWER	29 (6.1%)	18 (3.8%)	30 (6.3%)	35 (7.4%)
HIGHER	410 (86.1%)	422 (89.0%)	431 (90.4%)	411 (86.3%)
SAME	37 (7.8%)	34 (7.2%)	16 (3.3%)	30 (6.3%)

TYPE	BLACK	HISPANIC	ANGLO
LOWER	46 (7.2%)	43 (6.8%)	23 (3.6%)
HIGHER	559 (88.2%)	540 (85.2%)	575 (90.6%)
SAME	29 (4.6%)	51 (8.0%)	37 (5.8%)

TYPE	MALE	FEMALE
LOWER	47 (4.9%)	65 (6.8%)
HIGHER	843 (88.6%)	831 (87.3%)
SAME	61 (6.4%)	56 (5.9%)

TYPE	NONLOW INCOME	LOW INCOME
LOWER	39 (4.1%)	73 (7.6%)
HIGHER	851 (89.7%)	823 (86.3%)
SAME	59 (6.2%)	58 (6.1%)

A flaw in several previous studies was not using a separate measure of achievement for correlating gain and achievement level. In the present study previous year (1981) ITBS achievement was correlated with gain and types of response changes. Consistent with previous research, achievement level was found to be positively correlated with gain (see Tables 7 and 8). Achievement gain for the total sample was significantly correlated with previous achievement ($r = .2147$, $p = .001$), with grade level correlations ranging from .1075 ($p = .001$) at grade 2 to .3314 ($p = .001$) at grade 8. In addition, previous year's achievement was positively correlated with W-R changes ($r = .1729$, $p = .001$) and negatively correlated with the number of R-W ($r = -.0738$, $p = .001$) and W-W ($r = -.2360$, $p = .001$) changes. It is important to note that while low achievers made fewer W-R changes, they still profited from those changes.

In addition to descriptive statistics, ANCOVAR, MANOVA, and ANOVA techniques were utilized to test for significant differences by ethnic group and family income level. ANCOVAR (with previous achievement as the covariate) was used to account for differences in student achievement level. Since the dependent variables are related to each other, a MANCOVAR was performed for R-W, W-R, and W-W changes, to determine significance for those combined changes. To see if grade level was significant (students at each grade level took a different number of test items, and the number of answer changes typically is influenced by test length), an ANCOVAR procedure was performed with grade included as a variable. If grade was significant, grade level results would need to be used as the basis for accepting or rejecting hypothesized relationships.

The ANCOVAR procedure with grade included as a variable revealed significant differences by grade in the total number of changes and in each type of change (R-W, W-R, and W-W). The adjusted means for these changes (see Appendix B) indicate that grade 2 students made the most total changes, and the most R-W and W-R changes. This occurred in spite of some of the grade 2 tests being read to the students by the teacher, which would inhibit rechecking (and changing) answers.

Some general aspects of anxiety and impulsivity-reflectivity found in the research literature led to specific hypotheses regarding ethnic group and family income differences in answer-changing behavior. Anglo students tend to be less anxious than minority students (Holtzman, Diaz-Guerrero, & Swartz, 1975), which should promote more of a willingness to change answers to obtain success and praise. In addition, Anglo students have been found to be more reflective than minority students (Tebeleff, 1978), which should enhance the likelihood of changing from an incorrect to the correct answer. However, the results from this study do not support the assumption that Anglo students would make more response changes and greater gains than minority students. Black students made the most changes, for the total sample ($p = .015$) and at grades 2 ($p = .049$) and 4 ($p = .018$). Anglo students made the fewest changes, with achievement level accounted for through covariance techniques.

If Anglo students made more answer changes than minority students (which was not supported by this study), then it would follow that Anglo students would probably make a larger gain from answer changing. However, no significant ethnic group differences for gain were found for the sample as a whole. When the data was analyzed by grade, Black students made a significantly larger gain in grade 2 than other students.

The author speculated that part of the prevailing difference in minority-majority achievement on standardized tests may be due to a difference in answer-changing behavior. If minority students change fewer answers and thus have a smaller gain, their standardized achievement test scores may be lower, in part, due to a differential pattern of changing answers and not entirely because of their knowledge level. The data from the present study does not provide any support for this hypothesis. On the contrary, it appears that Black students make more changes than Anglo students, and receive significantly more benefit at grade 2.

Differences in answer-changing behavior due to family income were hypothesized to affect both the number of response changes made and gain from changing answers. The number of changes was not significantly different by family income level. However, for the sample as a whole, students from low-income families gained an average of one-half item less than nonlow family income students ($p = .014$). It appears that low family income students receive less benefit than higher income students from about the same number of answer changes.

TABLE 7

CORRELATION BETWEEN PREVIOUS YEAR ACHIEVEMENT (1981)
AND GAIN IN ITEMS (#W-R MINUS #R-W)

	Correlation
Total Sample	.2147 p = .001
1982 Grade	
2	.1075 p = .001
4	.1951 p = .001
6	.2144 p = .001
8	.3314 p = .001

TABLE 8

PEARSON CORRELATION COEFFICIENTS FOR 1981 ACHIEVEMENT
AND TYPES OF CHANGE

		Changes		
Students	Total	R-W	W-R	W-W
All				
r	-.0095	-.0738	.1729	-.2360
sig.	.339	.001	.001	.001
Grade 2				
r	-.1792	-.1958	.0108	-.3355
sig.	.001	.001	.407	.001
Grade 4				
r	.0183	-.0503	.1704	-.1811
sig.	.345	.137	.001	.001
Grade 6				
r	.0622	-.0381	.1915	-.1132
sig.	.087	.203	.001	.007
Grade 8				
r	-.0093	-.1159	.2565	-.2960
sig.	.420	.006	.001	.001

Educational Importance

The results from this study indicate that the answer-changing behavior of elementary and junior high students is very similar to that of undergraduate students. Thus, consistency is evident throughout the educational span. Students at all levels generally profit after changing answers on a standardized multiple choice test.

One of the purposes of this study was to investigate some test-situational factors which may inhibit the performance of certain segments of the public school population on standardized achievement tests. The results do not provide support for the contention that differences in minority-majority achievement may be due to a differential pattern of answer-changing behavior. Black students tended to make more changes than Anglo students, and in grade 2 they received significantly more benefit. In terms of family income, while low family income students change answers about as frequently as students from higher income families, their changes produced less benefit.

Low-achieving students do not perform as well as high-achieving students on achievement tests because their knowledge levels are not as high. Regardless of ethnic group status and family income level, these knowledge levels of lower achieving students need to be raised. Continued research into effective teaching strategies for low-achieving low family income and minority students is needed. Situational factors, such as those reported here, may account for some of the differences in majority-minority and high SES-low SES achievement. However, the educational community cannot wait for these factors to be isolated and then applied to classroom teaching.

The ITBS was constructed by professional testmakers, with most items not prone to the successful use of testwiseness tips. To the extent that items on teacher-made tests are answerable through the use of testwiseness tips, the proportion of wrong-to-right changes may increase for those students who are quite testwise.

The results of this study do not supply information as to why answers are changed, the reasoning behind changes, or how answer-changing behavior may be modified. However, the overwhelming conclusion supported by this data is that teachers should encourage their students to check their responses when taking standardized achievement tests and make changes if they feel they have not made the correct choice. Students should not be told to not make any response changes. Nor should students be told to make changes because the changed answers will be correct 56% of the time. The educational community must be educated on this aspect of test-taking behavior: the majority of changed answers are beneficial to the test-taker.

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APPENDIX A

Rules for Determining Answer Changes

1. If no definite marking (just pencil dot) do not mark.
2. If erased because of other change, do not count.
3. Do not count smudges.
4. If more than one change, select one option, keep track of it and randomly select other choices next time.
   (Example: 2 and 3 changed to 4
   select 2
   write down 2 to remember
   next time 2 and 4 changed to 1
   select 4 since 2 was changed last time
5. If answer changed to double bubble, mark final as a blank.
6. If bubble erased and remarked, do not count.
7. If double bubble, do not mark.
8. If did not make any attempt to erase mark, do not count as a change.
9. Only legitimate full marks count.

APPENDIX B

ADJUSTED AND UNADJUSTED MEANS OF INDEPENDENT VARIABLES FOR DEPENDENT VARIABLES
(ANCOVAR with grade as a variable and previous achievement as covariate)

Dependent Variable: Total Number of Answer Changes

Independent Variable		Adjusted Mean	Unadjusted Mean
Ethnicity:	Black	12.02	12.05
(p = .015)	Hispanic	11.39	11.41
	Anglo	11.00	10.96
Sex:	Male	11.20	11.21
(p = .050	Female	11.74	11.73
Family	Nonlow	11.54	11.52
Income:	Low	11.40	11.42
Grade:	2	13.02	12.99
(p = .001)	4	10.34	10.35
	6	11.54	11.55
	8	10.97	10.99

APPENDIX B - Continued

ADJUSTED AND UNADJUSTED MEANS OF INDEPENDENT VARIABLES FOR DEPENDENT VARIABLES
(ANCOVAR with grade as a variable and previous achievement as covariate)

Dependent Variable: Number of R-W Answer Changes

Independent Variable		Adjusted Mean	Unadjusted Mean
Ethnicity:	Black	1.99	2.04
(p = .049)	Hispanic	1.98	2.00
	Anglo	1.76	1.70
Sex:	Male	1.83	1.85
(p = .040	Female	1.99	1.98
Family	Nonlow	1.86	1.85
Income:	Low	1.96	1.98
Grade:	2	2.60	2.57
(p = .001)	4	1.45	1.46
	6	1.79	1.80
	8	1.80	1.82

APPENDIX B - Continued

ADJUSTED AND UNADJUSTED MEANS OF INDEPENDENT VARIABLES FOR DEPENDENT VARIABLES
(ANCOVAR with grade as a variable and previous achievement as covariate)

Dependent Variable: Number of W-R Answer Changes

Independent Variable		Adjusted Mean	Unadjusted Mean
Ethnicity: ($p = .029$)	Black	6.74	6.57
	Hispanic	6.31	6.23
	Anglo	6.19	6.43
Sex:	Male	6.37	6.32
	Female	6.45	6.50
Family Income:	Nonlow	6.58	6.71
	Low	6.24	6.11
Grade: ($p = .001$)	2	7.33	7.48
	4	6.08	6.03
	6	6.38	6.34
	8	5.85	5.78

APPENDIX B - Continued

ADJUSTED AND UNADJUSTED MEANS OF INDEPENDENT VARIABLES FOR DEPENDENT VARIABLES
(ANCOVAR with grade as a variable and previous achievement as covariate)

Dependent Variable: Number of W-W Answer Changes

Independent Variable		Adjusted Mean	Unadjusted Mean
Ethnicity:	Black	3.29	3.44
	Hispanic	3.11	3.18
	Anglo	3.05	2.83
Sex:	Male	3.00	3.05
(p = .008)	Female	3.30	3.25
Family	Nonlow	3.10	2.98
Income:	Low	3.20	3.32
Grade:	2	3.08	2.94
(p = .001)	4	2.82	2.86
	6	3.38	3.41
	8	3.32	3.38

APPENDIX B - Continued

ADJUSTED AND UNADJUSTED MEANS OF INDEPENDENT VARIABLES FOR DEPENDENT VARIABLES
(ANCOVAR with grade as a variable and previous achievement as covariate)

Dependent Variable: Gain (# W-R minus # R-W)

Independent Variable		Adjusted Mean	Unadjusted Mean
Ethnicity:	Black	4.74	4.53
	Hispanic	4.32	4.23
	Anglo	4.41	4.72
Sex:	Male	4.53	4.47
	Female	4.45	4.52
Family Income: (p = .014)	Nonlow	4.70	4.88
	Low	4.28	4.11
Grade: (p = .019)	2	4.72	4.91
	4	4.62	4.57
	6	4.58	4.54
	8	4.04	3.96